

AD-A033 672

CTS KNIGHTS INC SANDWICH ILL
PRODUCTION ENGINEERING MEASURES FOR TEMPERATURE COMPENSATED M_TC--ETC(U)
JUN 74 D L THOMANN

DAAB05-72-C-5839

NL

UNCLASSIFIED

ECOM-5839-6-72

1 of 1
ADA033672



END

DATE
FILMED
2 - 77

ADA033672



AD

PRODUCTION ENGINEERING MEASURES REPORT
DAAB05 - 72 - C - 5839

TEMPERATURE COMPENSATED MICROCIRCUIT CRYSTAL OSCILLATOR

SIXTH QUARTERLY PROGRESS REPORT

BY

Donald L. Thomann

1 JUNE 1973 TO 31 AUGUST 1973

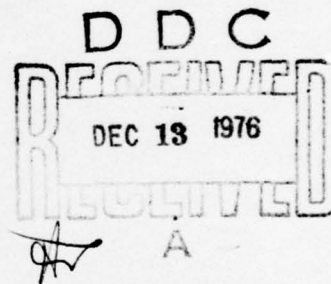
ECOM

Production Division, Procurement and Production Directorate
USAEOM, Fort Monmouth, New Jersey 07703

CTS KNIGHTS, INC.
SANDWICH ILLINOIS 60548

DISTRIBUTION STATEMENT

Distribution of this document approved for public release.
Distribution unlimited.



NOTICES

Disclaimers

The findings in this report are not to be constructed as an official Department of the Army position unless so designated by other authorized documents.

DISPOSITION

Destroy this report when it is no longer needed. Do not return it to the originator.

PRODUCTION ENGINEERING MEASURES
FOR
TEMPERATURE COMPENSATED MICROCIRCUIT CRYSTAL OSCILLATOR
SIXTH QUARTERLY PROGRESS REPORT

Contract No. DAAB05-72-C-5839

DISTRIBUTION STATEMENT

Distribution of this document approved for public release.
Distribution unlimited.

Prepared By

Donald L. Thomann

CTS KNIGHTS, INC.
SANDWICH, ILLINOIS

For

US Army Electronics Command
Fort Monmouth, New Jersey

APPROVED BY	
WFO	DATE
DDI	DATE
DISSEMINATION	
JUSTIFICATION	
BY	
DISSEMINATION	
DATE	
A	

ABSTRACT

A quantity of five MCTCXO engineering samples for each of the four contract frequencies were completed, tested for conformance to the specification, and submitted to ECOM for further evaluation.

The results of the test confirmed that the design is capable of meeting all the electrical requirements except power consumption. It is recommended that the specified power consumption be raised 20%.

A data package consisting of test data, drawings, a definitive specification per MIL-S-83490, and production layout was delivered with the engineering samples.

TABLE OF CONTENTS

<u>DESCRIPTION</u>	<u>PAGE NO.</u>
Abstract	i
Purpose	1
Discussion	2
Figure 1	3
Figure 2	5
Table I	6
Conclusions	7
Manpower Utilization Report	8
Distribution List	9
DD 1473 Form	12

PURPOSE

The purpose of the work performed during the Sixth quarter reporting period of 1 June 1973 to 31 August 1973 was to complete the assembly of five engineering samples of each of four frequencies and then to determine the degree of conformance of these units to Electronic Command Technical Requirements, SCS-357A, Amended by Special Note 6 of the contract.

DISCUSSION

The assembly of five MCTCXO engineering samples of each of the four contract frequencies was completed during this period. Testing was performed to demonstrate the degree of conformance of the design to the requirements of SCS-357A, amended by Special Note 6 of the contract.

ASSEMBLY

An exploded view of the final package design is shown in Figure 1. Final assembly was begun by mounting the crystal and lower substrate to the header. After functional check-out on the bench at room temperature, the MCTCXO's were placed in a fixture in a temperature test chamber. The required varactor voltage versus temperature at each of eight temperature points in the operating range was obtained for each unit. The required value of each component in the compensating network was then calculated from this data by means of a computer.

Each of the resistors on the compensation substrate were then abraded to value by means of a conventional "sand module" of the type used by resistor manufacturers. The one used was manufactured by S.S. White. The sand module was controlled by a commercially available "automatic stop resistance bridge". In operation, the desired resistance value is dialed into the bridge, the abrasive stream is started manually, and cermet resistor material is gradually removed. When the resistor being trimmed reaches the predetermined value, a comparator circuit within the bridge turns off the abrasive stream. A resistor tolerance better than 0.5% can be easily achieved in this way.

The network substrates were attached and temperature runs made to verify the units met specification. The units were then coldweld sealed in a dry nitrogen atmosphere maintained within glove box.

TEST RESULTS

Frequency vs. Supply Voltage. The unit with the greatest sensitivity to supply variation was S/N E10 with a deviation of 1.5×10^{-7} . The unit with the least sensitivity was S/N E18 with a deviation of less than 1×10^{-8} . The average of all units was 4.7×10^{-8} with a 5% supply change.

Frequency vs. Load. The unit with the greatest sensitivity to load change was S/N E9 with a deviation of 1.8×10^{-7} . The unit with the least sensitivity was S/N E17 with a deviation of less than 1×10^{-8} . The average of all units was 4.1×10^{-8} with a 5 pf load change.

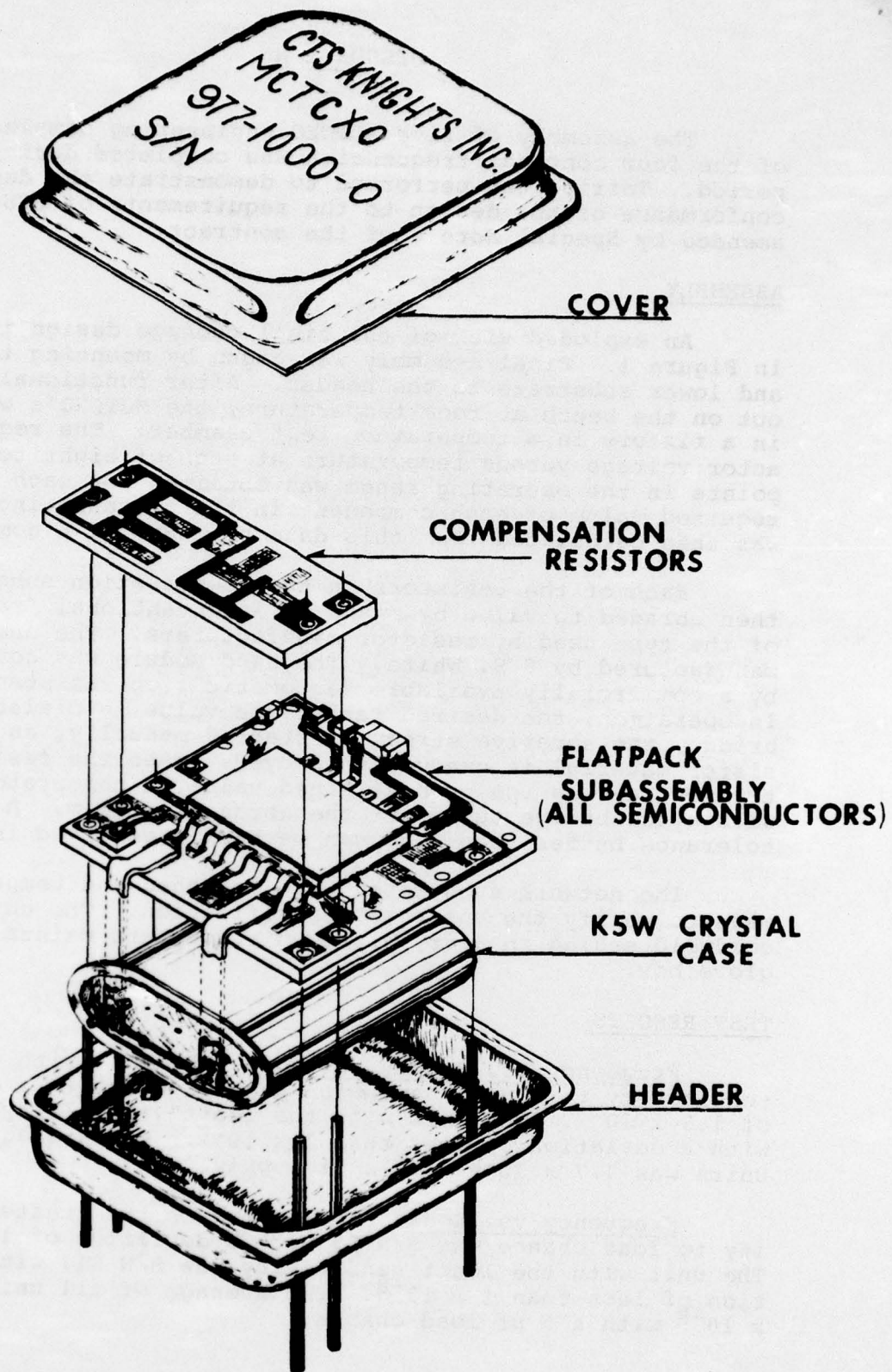


Figure 1

Frequency Adjust Range. The total frequency adjust range of all units was 8 ppm or greater, however, six of the units had inadequate trim or none in the positive direction. This is a result of the compensation network having an offset error of 2 to 3 ppm. This was a process error and is not related to the design itself.

Input Power. The unit with the greatest input current as a percentage of specification was S/N E9 with 138%. The unit with the least input current was S/N E12 with 105% of specification. The average of all units was 117% of specification.

Output Voltage. The value of Logic "0" for all units was 0.2 volt. The Logic "1" for most units was 11.5 volts with the lowest going down to 11.0 volts and three going to 12.0 volts.

Frequency vs. Temperature. All units met the frequency vs. temperature requirement of ± 2.5 ppm from -40°C to $+80^{\circ}\text{C}$ including any hysteresis resulting from running the test from hot to cold and then from cold to hot, as well as any skew in curve resulting from ± 3 ppm trim excursion. Typical curves obtained are shown in Figure 2.

Seal. Fifteen of the twenty units met the specified leak rate by a comfortable margin. Two units, S/N E1 and E16 were found to have leak rates of 1.2×10^{-8} atm cc/sec and 1.5 atm cc/sec respectively. Three other units, S/N E8, E9, and E15 were found to exceed the specified rate of 1×10^{-8} atm cc/sec, but were estimated to be less than 1×10^{-7} atm cc/sec. The design objective is considered to have been met.

Visual and Mechanical. The appearance of all units is acceptable. The dimensions of the units are $.855 \times .751 \times .353$. The product of these three dimensions results in a volume of .227 cubic inch. This is within the present design goal of 0.230 cubic inch.

If the volume of the MCTCXO is defined as being equal to the volume of water displaced when totally immersed, then a figure very close to 0.2 cubic inch, as originally specified, is obtained.

A summary of the performance achieved compared to the performance objectives is shown as Table I.

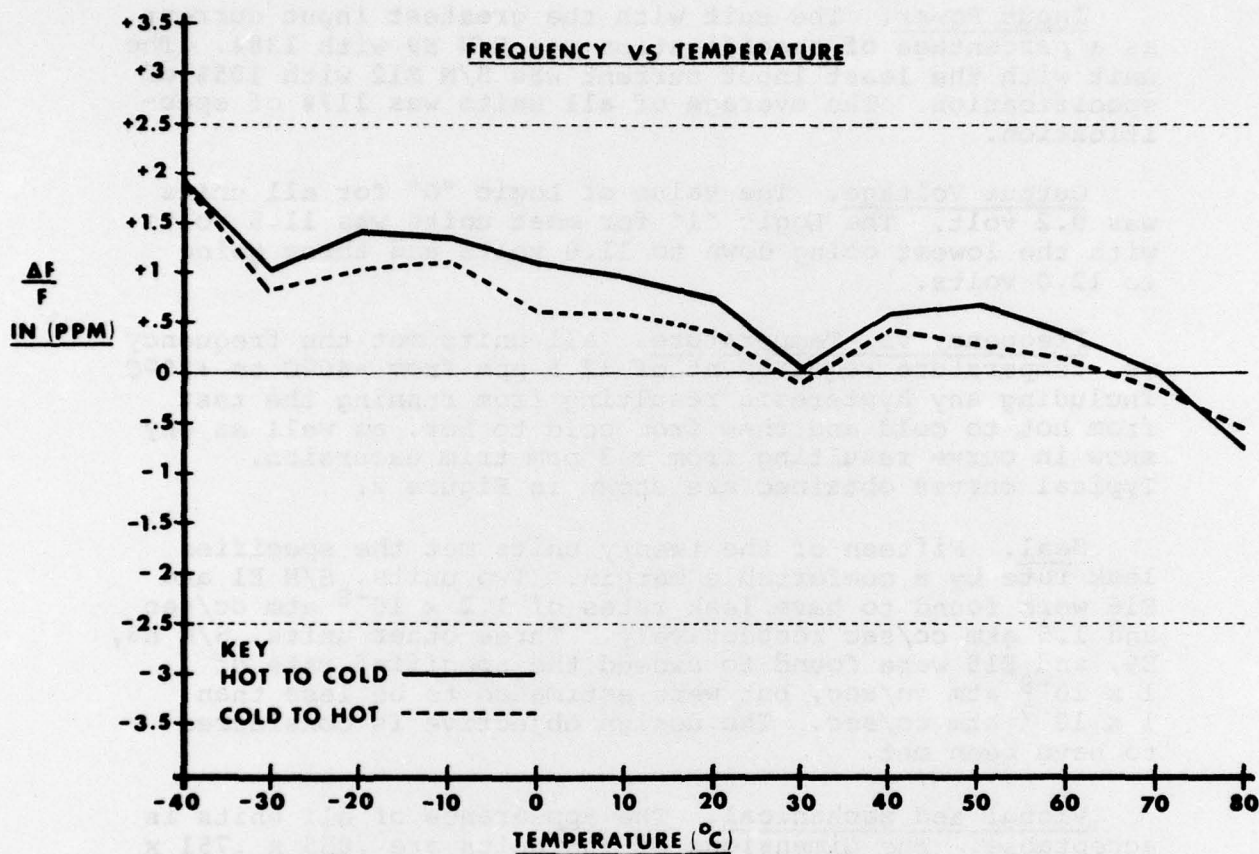


FIGURE 2

TABLE I

	<u>OBJECTIVE</u>	<u>ACHIEVED</u>
FREQUENCY RANGE:	3 TO 10 MHz	3 TO 10 MHz
FREQUENCY STABILITY:	+ 6 PPM OVERALL FOR 5 YEARS	TO BE DETERMINED
TEMPERATURE (-40°C TO +80°C):	+ 2.5 PPM	+ 1 PPM
VOLTAGE (+ 5% CHANGE):	+ 1 PPM	+ 1.5 X 10 ⁻⁷
LOAD (+ 5 Pf CHANGE):	+ 1 PPM	+ 1.8 X 10 ⁻⁷
TIME (2 WEEKS):	1 X 10 ⁻⁷	TO BE DETERMINED
FREQUENCY ADJUST RANGE:	+ 3 PPM	GREATER THAN + 3 PPM
INPUT POWER (+ 12 VOLTS):		
P _{MW} = 4.3 F (MHz) + 4.8	17.7 MW	20.5 MW
	21.3 MW	21.6 MW
	26.3 MW	26.0 MW
	47.8 MW	50.4 MW
CASE VOLUME:	0.20 IN ³	0.23 IN ³
SEAL:	1X 10 ⁻⁸ ATM CC/SEC	1 X 10 ⁻⁸ ATM CC/SEC
RELIABILITY:	1%/1000 HOURS 90% CONFIDENCE	TO BE DETERMINED

CONCLUSIONS

The testing performed on the MCTCXO engineering samples has demonstrated that the design meets or exceeds all the electrical requirements imposed except for power consumption. It is our opinion that the specified values of power consumption cannot be met on a practical basis at this time. It is recommended that the input current specification be increased by about 20%.

Although certain units were found to have insufficient trim in one direction, it was not related to the design. Rather, it was the result of a process error in determining compensation network values.

MANPOWER UTILIZATION REPORT

1 June 1973 to 31 August 1973

Contract No. DAABO5-72-C-5839

Donald L. Thomann
Design Engineer

S. Ill. Univ., B.S. Applied Science
U.S. Army, Redstone Arsenal, 2 years
Bendix Corporation, 3 years
Varo, Inc., 3 years
CTS Knights, Inc., Since 1969

Dr. D.E. Newell
Design Consultant

Iowa State Univ., B.S.
State Univ. of Iowa, M.S. & PhD.
Collins Radio Company, 6 years
State Univ. of Iowa, Assoc. Prof.,
2 years, Bendix Corporation, 4 years
Newell Labs, Inc., President, 1 year
CTS Knights, Inc., Since 1966

Roger Zimmermann
Technician

Wisconsin School of Electronics, A.S.
CTS Knights, Inc., Since 1969

Engineering Hours Expended

D.L. Thomann 692 Hrs.

Dr. D.E. Newell 322 Hrs.

Technician Hours Expended

R. Zimmermann 10 Hrs.

DISTRIBUTION LIST

- | | |
|--|--|
| (1) Bliley Electric Co.
2545 W. Grandview Blvd.
Erie, Pa. 16512
ATTN: Mr. G. Wright | (1) Sherold Crystal Co.
1510 McGee St.
Kansas City, Mo. 64108 |
| (2) Bulova Watch Co.
Electronics Div.
40-06 62nd St.
Woodside, N.Y. 11377
ATTN: Mr. C. Spreckels
Mr. P. Duckett | (1) Tedford Labs.
4914 Gray Rd.
Cincinnati, Ohio 45232 |
| (1) Erie Frequency Control
453 Lincoln St.
Carlisle, Pa. 17013
ATTN: Mr. R. Calaman | (1) Clark Crystal Co.
2 Farm Rd.
Marlboro, Mass. 01752 |
| (1) P.R. Hoffman Co.
321 Cherry St.
Carlisle, Pa. 17013 | (1) Monitor Products Co. Inc.
815 Fremont Ave.
S. Pasadena, Calif. 91103 |
| (1) McCoy Electronics Co.
Box 381
Mt. Holly Springs, Pa. 17065 | (2) Bell Telephone Labs.
555 Union Blvd.
Allentown, Pa. 18101
ATTN: Dr. W.J. Spencer |
| (1) Piezo Crystal Co.
100 "K" St.
Carlisle, Pa. 17013
ATTN: Mr. W. Samuelson | (1) General Electric Co.
Mobile Radio Dept.
Mountain View Rd.
Lynchburg, Va. 24502
ATTN: Crystal Design Eng. |
| (1) M-tron Industries, Inc.
100 Douglas Ave.
Yankton, S.D. 57078
ATTN: Mr. W. Mellecher
Chief Crystal Eng. | (2) Motorola, Inc.
4545 Augusta Blvd.
Chicago, Ill. 60651
ATTN: C. Rose
R. Bothwell |
| (1) Filtronix, Inc.
490 Via Del Norte
Oceanside, Calif. 92054
ATTN: Mr. R.E. Johnson | (1) Northern Eng. Labs., Inc.
357 Beloit St.
Burlington, Wis. 53105
ATTN: Mr. R. Holzrichter |
| (1) Reeves-Hoffman Div.
Dynamics Corp.
400 W. North St.
Carlisle, Pa. 17013
ATTN: Mr. H. Potter | (1) Int'l. Crystal Manufacturer
18 1/2 N. Lee St.
Oklahoma City, Okla. 73102 |
| | (1) Peterson Radio Co., Inc.
2800 W. Broadway
Council Bluffs, Iowa 51501 |

- (1) Savoy Electronics, Inc.
1314 N.E. 17th Court
Ft. Lauderdale, Fl. 33311
ATTN: Mr. R. Bassett
- (1) Valpey-Fisher Crystal Corp.
1015 First St.
Holliston, Mass. 01746
ATTN: Mr. G. Fisher
- (1) Lenkurt Electric Co.
San Carlos, Calif. 94070
ATTN: Mr. F. Fasteneau
- (1) Electronic Research Co. Inc.
10000 W. 75th St.
Overland Park, Kansas 66204
ATTN: Mr. N. Bishop
- (1) General Electric Supply Co.
Nat'l. Gov't. Sales Section
401 E. Hunting Park Ave.
Philadelphia, Pa. 19124
- (1) John K. Miller
252 Oriole Dr.
Pittsburgh, Pa. 15220
- (1) Hughes Aircraft Co.
Microelectronic Products Div.
500 Superior Ave.
Newport Beach, Calif. 92663
ATTN: Mr. H.E. Dillon
- (1) Hughes Aircraft Co.
Components Div.
Florence & Teals Sts.
Culver City, Calif. 90230
ATTN: Mr. L. Storch
- (1) Piezo Tech. Inc.
2400 Diversified Way
Orlando, Fl. 32804
- (1) Anderson Electronics, Inc.
310 Allegheny St.
Holidaysburg, Pa. 16648
- (1) Damon Engineering
240 Highland Ave.
Needham Heights, Mass. 02194
ATTN: Dr. D. Kossowsky
- (1) Texas Crystal Co.
1000 Crystal Dr.
Ft. Myers, Fl. 33901
- (1) Collins Radio Corp.
Components Div.
19700 San Joaquin
Newport Beach, Calif. 92660
ATTN: Dr. E.M. Frymoyer
- (1) Frequency Electronics, Inc.
3 Delaware Dr.
New Hyde Park, N.Y. 11040
- (1) Monsanto Co.
P.O. Box 8
St. Peters, Mo. 63376
ATTN: Mr. J. Erasmus
- (1) Nytronics, Inc.
10 Pelham Pkwy.
Pelham Manor, N.Y. 10803
ATTN: Mr. J.L. Denman
- (1) Q-Tech
11529 W. Pico Blvd.
Los Angeles, Calif. 90064
ATTN: Mr. W. Foulds
- (1) Naval Research Labs.
Code 5350
Washington, D.C. 20390
ATTN: Mr. B. Dodson
- (10) Defense Documentation Ctr.
Cameron Station
Alexandria, Va. 22314
- (2) Advisory Group on Electron
Devices
201 Varick St.
9th Floor
New York, N.Y. 10014
- (3) Director
US Army Elect. Labs.
Ft. Monmouth, N.J. 07703
ATTN: AMSEL-KL-S
- (2) Commanding General
US Army Elect. Command
Components & Materials Div.
Ft. Monmouth, N.J. 07703
ATTN: AMSEL-PP-EM

- (2) Commander
Naval Elect. Sys. Command
Dept. of the Navy
Code 051432
Washington, D.C. 20360
- (2) Commanding Officer
Tobyhanna Army Depot
Tobyhanna, Pa. 18466
ATTN: SIGTD-812
- (2) Headquarters
Air Force Logistics Command
Wright Patterson AFB, Ohio 45433
ATTN: SGMES-30/Miss Donson
- (1) Rome Air Development Ctr.
Griffiss AFB, N.Y. 13440
ATTN: EMERR, Mr. L. Gubbins
- (2) Director
US Army Elect. Labs.
Ft. Monmouth, N.J. 07703
ATTN: AMSEL-TL-SF/Mr. Schodowski
- (1) Executive Office of President
Office of Emergency Planning
Washington, D.C.
ATTN: Mr. W. Lawrence, Chief
Stockpile & Requirements
Division
- (2) Commanding Officer
Air Force Mat'l. Lab (MATE)
Patterson AFB, Ohio 45433
ATTN: Mr. Jules Wittebort
- (2) Commanding General
US Army Elect. Command
Ft. Monmouth, N.J. 07703
ATTN: AMSEL-PP-E
- (1) A.D. Bedrosian
US Army Elect. Lab. Liaison Ofc.
Mass. Institute of Tech.
77 Mass. Ave.
Room 26-31
Cambridge, Mass. 02115
- (1) Western Electric
Merrimac Valley Works
1600 Osgood St.
N. Andover, Mass. 01845
- (1) Commanding Officer
US Coast Guard Sup. Ctr.
Crystal Lab.
31st St. & 3rd Ave.
Brooklyn, N.Y. 11226
ATTN: Code 80
- (1) Commanding General
US Army Missile Command
Bldg. 4488
Redstone Arsenal, Ala.
ATTN: AMSMI-ILS/Mr. Tharp
- (1) Mr. C.W. Friend
Patterson AFB, Ohio 45433
ATTN: AFAL-AVNT
- (1) Harry Diamond Lab.
Washington, D.C. 20438
ATTN: Mr. Claus Sann
- (1) Sacramento Army Depot
Sacramento, Calif. 95813
ATTN: AMXSA-MME-1a/Mr. Orr
- (2) US Army Prod. Equip. Agy.
Rock Island Arsenal
Rock Island, Ill. 61201
ATTN: AMSPE-MT
- (3) US Army Elect. Command
225 S. 18th St.
Phila. Pa. 19103
ATTN: AMSEL-PP/P-IM-1a
- (1) Norfolk Naval Shipyard
Portsmouth, Va.
ATTN: Code 967
- (1) Juergen Staudte
Statek Corp.
1200 Alvarez Ave.
Orange, Calif. 92668
- (1) Jan Crystals
2400 Crystal Drive
Ft. Myers, Florida
ATTN: Mr. J. Erasmus
- (1) Spectrum Technology Inc.
P.O. Box 948
Goleta, Calif.
ATTN: H. E. Gruen

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) CTS Knights, Inc. ✓ 400 Reimann Avenue Sandwich, Illinois 60548		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE ⑥ PRODUCTION ENGINEERING MEASURES FOR TEMPERATURE COMPENSATED MICROCIRCUIT CRYSTAL OSCILLATOR.			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) SIXTH QUARTERLY REPORT, 1 JUNE 1973 TO 31 AUGUST 1973			
5. AUTHOR(S) (First name, middle initial, last name) ⑩ Donald L. Thomann		⑨ Quarterly progress rept. no. 6, 1 Jun - 31 Aug 73,	
6. REPORT DATE ⑪ JUNE 1974		7a. TOTAL NO. OF PAGES 1 - 13	7b. NO. OF REFS 0
8. CONTRACT OR GRANT NO. ⑮ DAAB05-72-C-5839		9. ORIGINATOR'S REPORT NUMBER(S) ⑫ 14p.	
c. d.		10. OTHER REPORT NO(S) (How other numbers that may be assigned this report) ⑬ ECOM ⑰ 5839-6-72	
10. DISTRIBUTION STATEMENT Distribution of this document approved for public release. Distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. ARMY ELECTRONICS COMMAND	
13. ABSTRACT A quantity of five MCTCXO engineering samples for each of the four contract frequencies were completed, tested for conformance to the specification, and submitted to ECOM for further evaluation. The results of the test confirmed that the design is capable of meeting all the electrical requirements except power consumption. It is recommended that the specified power consumption be raised 20%. A data package consisting of test data, drawings, a definitive specification per MIL-S-83490, and production layout was delivered with the engineering samples. (U) 2			

DD FORM 1473
1 NOV 65

12

Unclassified

Security Classification

101930
LB

14	KEY WORDS	LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
	TCXO Temperature Compensated Crystal Oscillator Crystal Oscillator C-MOS						